DEVELOPMENT OBJECTIVES SPLIT-FORMAT 1540 LIGHT TABLE AND MOUNT FOR VARIOUS MICROSTEREOSCOPES

24 July 1969

1. INTRODUCTION

These development objectives describe the requirements to be met in the design and development of a prototype Split-Format 1540 Light Table with mount for various microstereoscopes. Ease of film loading, superior illumination, and a precision microstereoscope mount are sought after characteristics.

2. GENERAL DESCRIPTION

This table will incorporate two separate 15" by 20" illuminated areas adjacent to each other along their shorter dimension so that their combined measurements will be approximately 15" by 40". The longer dimension of these light sources will be parallel to the length of the spooled film/s being viewed.

Provision will be made for viewing single rolls of 70mm, 5", 6.6", or 9.5" wide film; parallel viewing of two of the same width, or any combination of two different widths, of 70mm, 5", or 6.6" wide film; and in-line viewing of two of the same width of 70mm, 5", 6.6", or 9.5" wide film. The table will accommodate spools ranging up to and including the size of spool specified in Military Standard MS26565-22 loaded to capacity with film. In addition, the capability of accommodating spools ranging up to and including the size of spool specified in Military Standard MS26565-20 will be costed as an optional feature.

The table will include a simple film looping mechanism which will allow forming a loop of film below the table in order that separated film frames, on the same roll of film, may be arranged adjacent to each other for convenient stereo viewing. Looping of parallel rolls of film will not be required. This mechanism will be capable of forming a continuous film loop from 0 to 76 inches. In addition, the capability of forming a continuous film loop up to 27 feet will be costed as an optional feature.

A mount capable of being translated in both the X and Y directions will be incorporated to support the microstereoscope at the correct height above the light table surface.

3. REQUIREMENTS

3.1. Illumination Sources

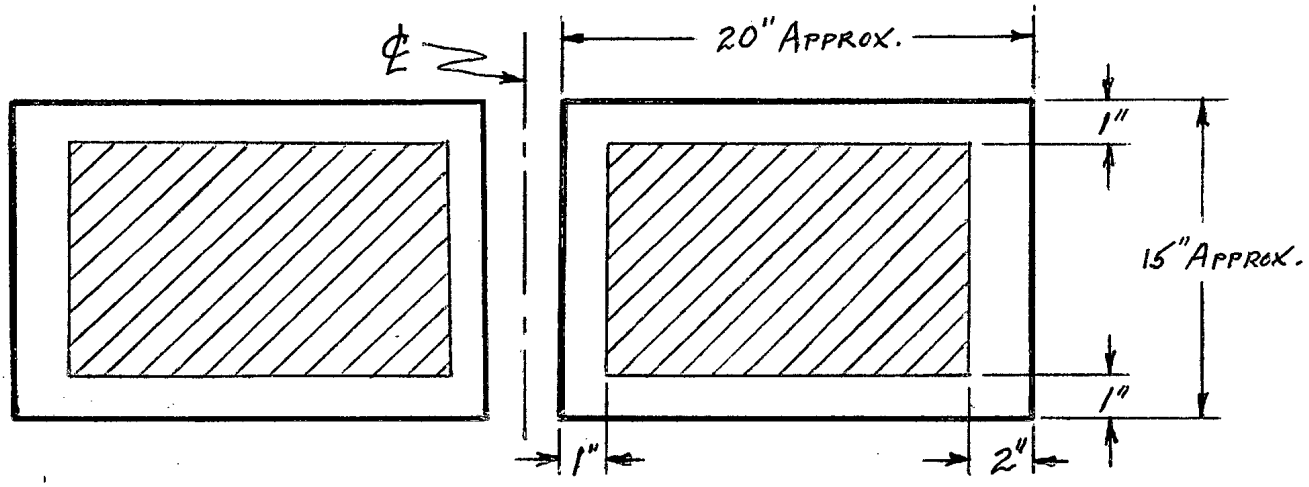
3.1.1. General - Two separate glass formats, 15" ± 1/2" X 20" ± 1/2" in size, will be illuminated by easily replaced fluorescent-type sources. The distance between the two adjacent illuminated areas will not exceed 1 1/4 inches during normal viewing operations. In addition, the capability of synchronous tilting of the illuminated areas and the microscope mount and carriage, by means of a motorized drive continuously throughout the range of 0 to 15 degrees will be costed as an optional feature.

3.1.1.1. Illumination Level - Each of the illumination sources will provide a maximum level of at least 3,000 foot lamberts measured at the glass viewing surface, within a 2" radius of its geometric center, at any time after a minimum of 30 minutes continuous operation. The maximum levels of the two illumination sources will not differ by more than 100 foot lamberts at the time of this measurement. The minimum level of each of the sources will be 75 foot lamberts, measured at the glass viewing surface, within a 2" radius of its geometric center. Between these two extremes, the illumination level will be continuously variable in one step or throughout each of two over-lapping steps which will be selected by appropriate switching. Logarithmic control of the illumination level will be included, with the slow response of the control at the low illumination levels. With one of the two sources set at maximum or minimum illumination level, there will not be a change of more than 100 foot lamberts in the illumination level of that source when the illumination level of the other source is adjusted throughout its full range. Measurements will be taken with a Government furnished foot lambert meter.

3.1.1.2. Color of Illumination - Broadband white illumination will be required with an equivalent color temperature between 3,000°K to 5,000°K at all luminance levels. The phosphor chosen will minimize radiation below 380 nanometers and above 750 nanometers. Radiation below 380 nanometers will be limited to 0.5 microwatts/cm^2. Radiation above 750 nanometers will be limited to 0.025 watts/cm^2.

3.1.1.3. Uniformity of Illumination - The maximum linear brightness gradient for each of the illumination sources will not exceed 15% between any two measurements taken within the shaded areas on the following diagrams. In addition, the brightness gradient will be no greater than 30% over the entire 15" X 20" illuminated areas. The measurements for gradient will

will be made with the Government furnished brightness meter, keeping the sensing aperature of the meter wholly within the above defined boundaries. The gradient measurements will be taken at three illumination levels of approximately 1,000, 2,000 and 3,000 foot lamberts.



3.1.1.4. Flicker - Flicker frequency of each of the illumination sources will exceed 80 Hertz except for low luminance (less than 100 foot lamberts) where frequencies down to 60 Hertz are acceptable. Beat frequencies of multiple lamp sources will exceed the above levels.

3.1.1.5. Heat - The illumination sources will be able to function continuously at maximum intensity over a 24-hour period, in a room with an 80°F ambient temperature. In addition, with film of 2.0 density covering at least 66% of the illuminated glass viewing surface, and the remainder masked, the temperature of the film will not exceed 100°F, or 30°F over ambient, whichever is higher. Also, no external surface of the table, or of the ancillary equipment will exceed 110°F or 30° over ambient, whichever is higher. These temperature measurements will be taken with illumination at maximum intensity and after temperature and light intensity stabilization of the light sources.

3.1.1.6. Diffuser - A suitable diffuser will be located between the glass viewing surface and the light emitter of each illumination source.

3.1.1.7. Shade - Shades will be provided at each of the illumination sources to mask light from the viewing surface not actually covered by film. Each shade will be located between the diffuser and the glass viewing surface of the illumination source, will be mounted along the long dimension of the unit, and will be extendible across the short dimension toward the operator's normal position, i.e., back to front. Means will be provided for easy, convenient, extension,

retraction, and firm intermediate positioning of the shade between its extremes of operation. These extremes will be the fully retracted position, where the shade will not encroach upon the illuminated area, and the fully extended position, where the shade will mask the unused portion of the glass viewing surface when viewing a single 70mm wide roll of film. In addition, a separate, easily positioned shade, 0.5 inches wide (paragraph 3.3.1.2. pertains)will be provided for masking light from the area between two films when viewing them in parallel (paragraph 2 pertains). This latter shade will move in the Y direction from the front or operators side of the table and will not encroach upon the illuminated area when not in use. Non-mechanical means of shading will be acceptable if they produce the same results as the requirements for the mechanical shade described above.

3.2 External Configuration

3.2.1. General - The basic features mentioned in Paragraph 2, together with their necessary sub-components, will be built on or as a part of a convenient and sturdily designed elevating table.

3.2.1.1. Size - The entire unit will measure no more than 62 inches in length, including film supports, and 31 inches in depth (front to back). Protrusions beyond the depth dimension will be easily demountable with quick-disconnect type connections. The distance from the glass viewing surface to the bottom of the light table proper, i.e., the light enclosure and 0 to 76 inch film loop mechanizm, will not exceed 5.5 inches. A hinged cover will be provided to enclose the under side of the film loop takeup area.

3.2.1.2. Weight - The entire unit, including the elevating table, will weigh 600 pounds or less.

3.2.1.3. Elevating Table - The light table and microstereoscope mount will be built on, or an integral part of, an elevating table. This table will be conveniently adjustable by means of a motorized drive throughout a range of height, measured from the floor to the bottom of the light table proper, of 22 inches to 40 inches. The table will be stable with no danger of tipping at all heights, up to and including its maximum extended position of 40 inches. The elevating mechanism will provide firm positioning and locking of the light table proper throughout the elevation range by means of a motor driven mechanism. Also, an emergency auxiliary hand crank will be incorporated that will smoothly and easily raise and lower the table, and provide firm positioning and locking of the light table proper throughout the elevation range. In addition,

the capability of elevating the table solely by means of a manual hand crank, rather than by motor drive, will be costed as an optional feature. Manual operation of the elevating mechanism will produce response as fast as practicable and yet require no more than 12 pounds force on the actuating handle of a crank which will have a radius of 3 to 4 inches. Positive stops will be provided to prohibit travel above or below the specified range of height for the elevating table of 22 inches to 40 inches. The table will be equipped with resilient-tired wheels, with minimum dimensions of 5" diameter by 1 3/4" width, each of which will have its own easily applied foot actuated, locking-type brake to prevent both the caster from swivelling and the wheel from rotating.

3.2.1.4. Viewing Position - The light table and the translating microstereoscope mount will be designed to offer the microstereoscopes (Paragraph 3.5.1. pertains) in a comfortable viewing position with the operator standing or seated. It is understood that these conditions relate to the height of the illuminated glass viewing surface, the requirement for associated rhomboids to adequately clear the film, and the varying working distances of the rhomboids of the mictostereoscope.

3.2.1.5. Location of Controls - All controls, including the film hand wheels, will be positioned so they can be easily manipulated. In this respect, the following functional arm reach distances will apply.

HEIGHT ABOVE SEAT REF. PT. (IN.)	ANGLE FROM STRAIGHT-AHEAD REACH						
	0°	15°	30°	45°	60°	75°	90°
0				16.0	17.9	17.4	18.5
6	17.0			22.4	23.8	23.9	25.6
12	19.4	21.5	23.5	24.9	27.0	27.6	28.0
18	21.3	22.9	25.4	26.9	28.1	29.3	30.0
24	21.6	23.4	24.9	26.4	28.0	28.9	30.0
30	20.1	22.0	23.7	26.4	27.4	28.3	29.3
36	17.4	18.7	20.2	22.4	23.9	25.1	25.9
42	12.7	13.2	13.6	16.0	19.2	20.3	21.1

NOTE: a. Reach dimensions are in inches forward of the seat reference point. This point is at a horizontal distance of 15 inches from the front of the table, 18 inches above the floor, and on the centerline of the table.

b. Add to the tabular dimensions 1 inch if knobs are to be operated and 3 inches if toggle switches or push buttons are used.

3.2.1.6. Finish - To reduce specular glare, which may interfere with efficient operator performance, the external surfaces of the entire light table unit will have non-glossy finishes with a reflectance of 25 to 30% (MIL-STD-803A-2 USAF).

3.3. Film Spool Support

3.3.1 General - Four film support stations will be provided to accommodate the various film widths and combinations described in Paragraph 2. They will be designed so that they will support the heaviest full spools of film (1,000 ft. of 9 1/2" wide, 4 mil base film or the optional 500 ft. of film) when the spools are rotating at any film slew speed developed by the drive system.

3.3.1.1. Loading Mechanism - A means will be provided for fast loading and unloading of either a single or two rolls of film of the widths and combinations set forth in Paragraph 2. This loading system will operate quickly and at the same time be positive in action. The spindle mechanism which engages and secures the spool will be designed for easy one hand operation so that the fully loaded spool can be held in one hand while the holding mechanism is activated with the other. A positive but quick release lock will be incorporated.

3.3.1.2. Brackets - At both ends of the table, three holding brackets will be provided on each of the upper film support stations, two brackets on each of the lower film support stations. All brackets will be removable, will operate freely on their ways to facilitate positioning, and will be equipped with a quick locking mechanism to hold them firmly in any selected position. The middle bracket of the upper film support stations will provide for 0.50" $\pm$ 0.05" inch spacing between the two parallel webs of film, and will be rigid enough to support the largest full roll of film specified in Paragraph 2, and under the conditions specified in Paragraph 3.3.1., without auxiliary means of support, under all operating conditions with either single or double spools of film. Film drive spindles on the brackets will incorporate keys to mate with the drive slots in the flanges of the film reels.

Idler spindles will not be keyed. A visual reference scale and indexing device with positive detents will be provided to allow accurate positioning of the brackets to hold the various width spools and assure accurate tracking across the glass viewing surfaces of the film parallel to the longitudinal axis of the light table and to each other.

3.4. Film Transport

3.4.1. General - The film transport will be designed for motorized operation, with a manual drive costed as an option.

3.4.1.1. Film Capacity - Each film support station, and its associated film transport will be capable of handling the various width films and combinations thereof as described in Paragraph 2.

3.4.1.2. Film Movement - Provision will be made for bi-directional movement of the film at each film support station by means of motors of suitable capacity. The film drive motors will be controlled by a control knob configured for high and low speed ranges. The low speed range will provide positive and smooth film positioning throughout a range of speeds of 0 to 1 inch per second. The high speed range will provide positive and smooth film positioning throughout a range of speeds of 0 to 500 feet per minute. The maximum speed on the high speed range will permit 1000 feet of 4 mil base, 9 1/2" wide film to be transported in three minutes or less. With the 500 foot roll option, the maximum speed on the high speed range will permit 500 feet of 4 mil base, 9 1/2" wide film to be transported in one minute or less. The film drive, in the maximum speed range, will be capable of maintaining a film speed of 20 inches per second.

With two rolls of film mounted in parallel, it will be possible to drive one of the rolls in one direction and the other roll in the opposite direction, individually or simultaneously. Also, with two rolls of film mounted in parallel, it will be possible to drive both rolls of film in the same direction individually or simultaneously. An attachable manual film transport drive capable of film movement will be included for emergency power off operation. In addition, a manual film transport drive which will provide positive and smooth film positioning and the same directional film movement as the motorized drive system will be costed as an optional feature.

3.4.1.3. Rollers - A minimum number of rollers will be positioned so that film can be transported either emulsion up or emulsion down. The rollers will have a surface that does not scratch the film. Motion of the rollers, while transporting one web of film, will not cause translation of a parallel web of film.

3.4.1.4. Film Tension - Both the motorized and the optional manual drive systems will maintain enough tension on the film at all film speeds and conditions of acceleration and deceleration of the film to prevent slack loops of film from forming. The motorized tension system will produce a film web tension of no more than 2 pounds per inch of film width. The optional manual film drive will incorporate solid-disk handwheels with revolving handles. The handles will be mounted on the handwheels on a 2 1/2 inch crank radius.

3.5. Microstereoscope Carriage and Mount

3.5.1. General - A precision mount will be provided to place either of the following three microstereoscopes in correct position for focus and for comfortable viewing of film materials located on the two 15" by 20" glass viewing surfaces: (a) Bausch & Lomb Zoom 70 Stereoscope with or without 2X wide-span rhomboid attachments; (b) Bausch & Lomb Zoom 240 Stereoscope System with Wide-Span Rhomboids; (c) Bausch & Lomb Zoom 240 Stereoscope with the Advanced Stereo Rhomboid, Model II; (d) Bausch & Lomb Versatile Stereoscope with all relays, i.e., 0.43X, 1.0X, and 4.0X; (e) Bausch & Lomb Dual Power Measuring Macroscope. The following general criteria will apply: (1) Design and positioning of carriage and mount will permit convenient access for installation and removal of viewing instruments and film. (2) Mounting devices will be sufficiently rigid to preclude instrument misalignment and loss of collimation of the optics with respect to the viewing surface during normal handling and operation. (3) Control of the microstereoscope carriage in X and Y translation will require only one hand for operation. (4) Provision will be made to preclude accidental damage from contact of the optical instruments with the structure of the table. (5) Counterbalances or some other means will be incorporated to preclude unwanted motion of the carriage when in the optional tilted position.

3.5.1.1. Focus - A readily accessible fine and coarse focusing adjustment will be furnished as an integral part of the mount. These adjustments will be smooth acting with minimum play between the hand controls and the actual mechanism. The fine focus will be adjustable at all points within the range of the coarse focusing adjustment.

3.5.1.2. Translation - With any of the microstereoscopes fixed in the mount, and using the center of the scope as a reference, translation in the Y direction will be adequate to cover the full 15" depth of the glass viewing surface. Translation in the X direction will be maximum commensurate with the overall length of the glass viewing surface and the mount clearance requirements. Also, it is required that the horizontal plane of the stereoscope mount and the viewing surfaces be parallel within 0.015 inches over the entire translation field of the stereoscope mount. A motorized drive capable of driving the mount at traverse speeds within the range of 0 to 0.5 inches per second will be incorporated. Manual translation of the microstereoscope mount will be costed as an optional feature and will incorporate the same capability, with respect to the distances of translation and parallelism of stereoscope mount and viewing surfaces, as the motor drive system.

3.5.1.3. Carriage and Mount Rigidity - Because of the high magnification, small depth of focus, and long cantilever of the rhomboid relay systems, the microstereoscopes to be used on this table are extremely susceptible to vibration. Therefore, the carriage and mount will be designed so that, when viewing at the highest magnification and/or the longest rhomboid relay system, there will be no visible vibrations induced by the light table itself, with the microstereoscope mount positioned anywhere within its range of travel.

3.5.1.4. Carriage Motions - The motions of the carriage mount will have low friction coefficients, be smooth (without binding) and positive acting, and as free of self-induced vibrations as possible. With the carriage lock disengaged, or with the motor drive deactivated, a force of 2 pounds or less will be sufficient to move the carriage in any combination of X and Y directions, in either the horizontal or optional tilted positions.

3.5.1.5. Locks - The focusing mechanism will be self-locking, or a firm, conveniently actuated locking capability will be designed into the focusing mechanism. Easily engaged locks will be provided to hold the mount of the microstereoscope carriage firmly at any position of its travel in the X and Y directions. With the carriage locks engaged, a force of 10 pounds or greater will be required to move the carriage in any combination of X and Y directions. If this carriage lock is electrically operated, additional locking devices will be included to preclude carriage motion during transportation of the table.

3.6. General Requirements

3.6.1. Construction - This equipment will meet the highest commercial standards of construction.

3.6.2. Maintenance - Ease of maintenance will be a primary consideration in the design of this light table. Convenient access to the internal portions of the table will be effected by strategic location of cover plates or access panels equipped with quick acting captive screws. Indicator lights will be easily replaceable from the front of the panel. A complete and accurate circuit diagram will be provided for easy reference (e.g., mounted inside an access panel). Any special tools required for routine maintenance will be provided. A simple elapsed-time meter will be attached to the main power circuit.

3.6.3. Cooling - If liquid coolant is required for the high intensity light source, it will be of a type which is not injurious to operating or maintenance personnel or to the equipment itself. An easy coolant replenishment method will be provided. In addition, all areas of the cooling system will be accessible for inspection and maintenance. If a coolant over-temperature warning light is incorporated, it will be red in color and prominently displayed.

3.6.4. Noise - The noise generated by the components of the table, in both static and dynamic conditions, will be regulated so as to minimize annoyance to either the operator or other workers in the area. Maximum equipment noise energy levels will not exceed the Noise Criterion 45 curve values set forth in the noise criterian (NC) curves attached. Energy levels concentrated in narrow bands (e.g., transformer hum, fan noise, etc.) will be at least 10 decibels below the NC-45 curve values. Noise measurements will be taken at a point approximately 48 inches above the floor and approximately 15 inches in front of the center of the table.

3.6.5. Vibration - Vibration generating components (e.g., film drive motors, ventilating fans, pumps, etc.) will be mounted so as to provide maximum vibration attenuation at frequencies above 5-10 Hertz. The intent of this requirement is to prevent light table induced imagery vibrations. It will be tested by viewing a target through the various microstereoscopes with power off, and noting if degradation of imagery occurs with the light table systems on. Natural frequencies or resonances of the table above 10 Hertz will be attenuated.

3.6.6. Safety - The following minimum safety precautions will apply: (1) all external, non-current carrying metal parts will be electrically connected and grounded. (2) Provision will be made to prevent

personnel from coming into contact with electrical circuits operating with an open circuit potential of 30 volts or more and a capability of delivering 2.5 peak milliamperes or more into a short circuit. (3) Glass table surfaces will be 3/8" thick, ground and polished both sides, plate glass. (4) Moving parts such as ventilating fans, drive belts, or gears, will be shielded or enclosed to prevent inadvertent access by the operator. This requirement does not necessarily apply to the film spool, film, and film spool spindles. However, all handwheels will be disconnected and non-rotating while their respective motorized systems are being operated. (5) Sharp edges or corners will be avoided. (6) Design will preclude inadvertent blockage of ventilating air intakes or exhausts. (7) Ventilating air exhaust will be directed away from the operator. (8) Appropriate and highly visible warning signs will be strategically placed as necessary.

3.6.7. Controls - Operating controls which are placed on the front of the long side of the table nearest the operator will not protrude above the plane of the working surface. A power switch, which may be easily differentiated from all other switches will be strategically placed and will have associated it with a frosted white power-on warning light. This light will cause a minimum of interference to the operator's vision when he is engaged in normal film viewing activity. If a preheat circuit is employed for the light source, the main power switch will incorporate a three position switch: OFF-PREHEAT-POWER ON. The main power switch will have associated with it a white frosted indicator light which will be on when the switch is in either the PREHEAT or POWER ON position. When the switch is in the PREHEAT position, only the preheat circuit will be energized. In the POWER ON position, all circuits will be energized. Both POWER ON and PREHEAT circuits will be adequately fused. All controls will be clearly marked and conform to human engineering practices with respect to location, size, shape, and ease of manipulation. Controls for illumination and film transport will be shape coded so as to allow non-visual operation. Pictograms will be used to describe proper motor rotation switch settings for various film loadings.

3.6.8. Power - This equipment will be capable of operating in all modes on 117 volt, plus or minus 15 volts, 60 Hertz, single phase, alternating current. Circuit breakers of suitable capacity will be supplied to prevent circuit overloads. A retractable, lockable, heavy duty, Underwriters Laboratory approved, 3-conductor electrical extension cord with a 3-prong plug attached to the extension cord by screws and incorporating a cord clamp, will be furnished with the table for connection to the operating power source. This cord will be at least 20 feet long.

4. MISCELLANEOUS

4.1. Proposal Format - The submitted proposal will conform to the attached Guide for Proposal format.

4.2. Reports, Manuals, and Inspections - Monthly progress reports will be required throughout performance of the contract. All reports will meet the basic requirements of Specification DB-1001, attached. An operator's and maintenance manual will be delivered with the prototype light table. This manual will be prepared in accordance with Specification DB-1003, attached. Periodic inspections will be made at the Contractor's facility by a Technical Representative of the Sponsor. Preliminary testing and evaluation will be performed at the Contractor's facility by a Technical Representative of the Sponsor to determine technical, operational, and human engineering acceptability of the prototype instrument. After preliminary acceptance, the instrument will be shipped, at the expense of the Contractor, to the Sponsor for more complete and detailed testing and evaluation. If modification is indicated, the instrument will be returned at the expense of the Contractor for appropriate changes.

4.3. Cost Estimates - A cost estimate will be submitted for a basic instrument incorporating the following capabilities: 1000 foot rolls of film, 0 to 76 inch film takeup loop, motorized table elevation, motorized film transport, and motorized microstereoscope carriage and mount. In addition, cost estimates will be submitted, as separate items, on the following optional capabilities: 500 foot rolls of film, 76 inch to 27 foot film takeup loop, motorized 0 to 15° continuous tilt of the illuminated surfaces and carriage, manual table elevation, manual film transport system, and manual transport of the microstereoscope carriage and mount. A retrofit/modular concept is intended for these optional items. Cost estimates will also be required, at the time of final acceptance of the prototype instrument, for quantities of 10, 50, 100, 200, and 300 production units of a Split-Format 1540 Light Table substantially similar to the prototype instrument fabricated under these development objectives.

GUIDE FOR PROPOSAL FORMAT

All proposals submitted for consideration must include the following information:

1. Task Abstract - A synopsis of the proposed solution of the task, including estimated total cost of the proposal.

2. Introduction - A summary of the background and rationale for the proposed solution of the task.

3. Technical Discussion - Subsections and details amplifying the summary in the Introduction above. If any requirements specified in the Development Objectives are considered undesirable or unattainable, it should be so stated and explained in this section.

4. Work Statement - A succinct description of the individual tasks and milestones to be achieved during performance of the contract. This section should be sufficiently definitive that a reading allows understanding of the purpose and scope of the tasks.

5. Deliverable Items - A statement of the items that will be delivered to the Sponsor during performance of the contract. This includes such items as interim and final reports, manuals, equipment, tools, spare parts, and drawings.

6. Scheduling - A PERT Chart, Step Chart, Time Bar Chart, or similar scheduling device from which progress of the contract can be determined. Also tables should be submitted indicating estimated monthly percentage completion of performance, and a related schedule of percentage of project expenditures.

7. Financial Statement - A statement of the estimated costs of direct labor, material, overhead, G&A, fees, and total cost of the proposed program. This section should also indicate the type of contract expected and any Government furnished equipment that may be required by the contractor during performance of the contract.